Research and development capacity building issues in the water sector of Ethiopia

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Abstract

Cognisant of the fact that research and development in the water sector is minimal and fragmented with little or no impact on the development of the sector, the National Mines, Water, Energy and Geoinformation Science and Technology Council designed a terms of reference for a consultancy study of the problem. The Ethiopian Science and Technology Commission and the Ministry of Water Resources jointly submitted a project to the Government for approval and Metaferia Consulting Engineers PLC was commissioned to carry out the study in July 2000 through funds secured from the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Government.

The consultant's findings have led to the conclusion that the establishment of a Water Resources Research and Development Institute is of crucial national importance for integrated management of R&D in the water sector. The institute is proposed to be an autonomous organisation having the overall responsibility and power for co-ordinating, guiding, funding, prioritising and undertaking R&D activities in the water sector at national level. The long-term (21–50 years) organisational objective of the institute is to establish a national R&D institute capable of undertaking most of the research needs of the water sector with a few centres of excellence being co-ordinated and funded by it.

The need for such an institute and its proper development and management is not only mandatory, but also urgent. This is because of the fact that gaps in the understanding of the characteristics of the water resources of the country limit the opportunities for judicious development of the sector, a task, we cannot afford to postpone for obvious reasons. The trans-boundary nature of the country's water resource base further complicates the situation. A well-managed R&D capability in the sector will therefore significantly contribute towards practical and multi-disciplinary solutions for such structural constraints.

The major short-term activities of the proposed institute include the legal and physical establishment of the institute; establishment of linkages with relevant national and international organisations; undertaking of R&D activities through its own programmes and co-ordination and funding of R&D activities of other centres in the sector.

Introduction

Ethiopia has a total area of about 1.13 million square kilometres and a total population of 64 million that is growing at an average rate of 2.95% per annum. Almost all economic and social indicators show that the country is one of the least developed countries in the world with an annual per capita income of about US$ 110. Agriculture accounts for about 50% of GDP and 90% of export earnings and is the means of livelihood for about 85% of the entire population. The contribution of the industrial sector to GDP is only about 12%. The dependence of the country on imported capital goods is very high. The import of manufactured consumer goods and capital goods, and some intermediate input for the manufacturing sector dominate the foreign trade sector. The export side is almost totally composed of primary agricultural products mainly: coffee, oil seeds, livestock and related products.

Traditional methods and tools of production predominantly characterise the agricultural sector of the country. Inputs from modern science and technology are insignificant. Recurrent drought and significant loss of soil due to environmental degradation have made the country a land of persistent poverty and famine. All socio-economic problems of the country are deep rooted largely in the absence of well-established scientific and technological base to generate and/or select and adapt scientific and technological knowledge to solve its development and environmental problems.

Historical background of R&D in Ethiopia

The systematic application of modern scientific methods to create and use modern knowledge in Ethiopia is of a relatively recent origin. Hence, the history of research and development in Ethiopia can go back only to the early 1950s when the Junior Colleges of Agriculture and the University College of Addis Ababa (UCAA) were established. Various records show that expatriate staff of the Colleges and the University College did most of the research published from 1960–70 as the teaching was started with only expatriate staff members. The research carried out during that time was mainly of theoretical nature. However, a small but growing body of Ethiopian scholars and scientists had begun to apply modern methods of scientific investigation to problems within Ethiopia by the early 1970s. And this had laid the foundation for the present R&D activities undertaken by the institutions of higher learning and other specialised research organisations (Bhagavan 1989).

The major institutions involved in the national R&D system of Ethiopia include higher education institutions where research is carried out to generate new knowledge. Most (though not all) of the research work undertaken in the universities is basic research. There are some specialised research institutions and/or centres within the Addis Ababa University (AAU) and the Alemaya University where multi-disciplinary research activities are carried out. There are also national institutions that carry out R&D for the government. The Ethiopian Agricultural Research Organization (EARO), together with the regional

agricultural organisations and the Ethiopian Nutrition and Health Research Institute (ENHRI) are the major ones engaged solely in R&D activities. The capacity building efforts of these institutions and the results obtained from their efforts so far are in fact appreciable.

Although the government allocates annual budgets to R&D institutions in the agriculture and health sectors, much of the projects and programmes undertaken by the universities are largely dependent on funds from foreign donors. The Ethiopian Science and Technology Commission (ESTC) channels part of the funds for the R&D activities undertaken by these institutions from the government treasury and/or bilateral and multilateral co-operations. The funds obtained from external donors are used mainly for import of equipment, instruments and other consumable supplies and for research training and travel of researchers abroad. Local funds mostly cover just salaries and local travel costs.

The local research grant scheme

The local research grant scheme, which has been instituted by the ESTC since 1999 is one of the mechanisms devised to make available government funds for the research community. The major objective of this grant is to encourage institutions and young researchers to engage in applied research. Through this scheme, a project can be granted up to Ethiopian Birr (ETB)[1] 25 thousand for research and up to ETB 50 thousand for prototype development. ETSC granted about ETB 9.5 million up to the 2001/2002 fiscal year for about 438 research and development projects. The scheme has definitely played a useful role in initiating R&D activities in a number of government institutions. It has also enabled new graduates to acquire experience on how to propose, plan, and undertake R&D project. Some useful results and information for further research have also been obtained from the scheme (ESTC 2002a).

The ESTC-SIDA/SAREC research co-operation

The most important source of research funding in Ethiopia to date is the Ethio-Swedish (ESTC-SIDA/SAREC) research co-operation programme, which began in 1979/80. This Swedish support aims at manpower training and research capacity building in Ethiopia. The participants in the Ethio-Swedish Research Co-operation framework include universities and autonomous research establishments within ministries on the Ethiopian side and university departments on the Swedish side. The co-operation supported about 70 research projects and the country has received over ETB 300 million in the last 22 years.

The Ethio-Swedish research co-operation has made a significant contribution in building research capability and strengthening the higher education sector of the country through MSc/MA and PhD postgraduate training programmes. It has also impact in the various research areas. For instance, registration of the Ethiopian plant species has been done through the Ethiopian Flora Project. A considerable capacity in selection and testing of medicinal and economically important plant species has also been built at the Chemistry Department of the Addis Ababa University through the Natural Products Chemistry

1. In 2002, US$ 1 = ETB 8.50.

Program. The research capacity built in the area of pest control through non-chemical integrated pest control at Awassa College of Agriculture is also one of the commendable achievements. In general, the SIDA/SAREC collaboration has contributed to enhancing scientific research tradition in the country, building and strengthening research capacity in relevant fields, producing an increased number of qualified researchers and upgrading of R&D infrastructure (ESTC 2002b).

Other organisations that provide research support in Ethiopia include:

- International Atomic Energy Agency (IAEA)
- International Foundation for Science (IFS)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- International Development Research Centre (IDRC) of Canada
- United Nations Development Program (UNDP)
- Russian Academy of Science, Third World Academy of Sciences (TWAS)
- Food and Agriculture Organization of the United Nations (FAO)
- European Union (EU)
- German Academic Exchange Service (DAAD)
- German Development Cooperation (GTZ) and
- International Development Association (IDA).

R&D in the water sector

Water scarcity and degradation in water quality are growing concerns for many countries around the world and the demands and pressures on global water resources are accelerating rapidly. Fresh water is limited and, for many people, insufficient to meet their daily needs, and yet global demand for water is expected to double within the next 15 years. According to World Bank estimates, US$ 70–80 billion are invested each year in the water sector in developing countries. If water consumption patterns continue at the present rate, it is estimated that two out of every three people will be living in a water-stressed environment by 2025 (IAEA 2002). The solution to these global water resource and water quality challenges is dependent on the development and sustainable management of water resources wherever and in whatever form they occur. Sustainable development and management of water resources are, in turn, critically dependent on our capability to generate new knowledge and/or new applications of the existing knowledge through scientific research.

Unlike the agricultural and health sectors, institutionalised water research is not known in Ethiopia. The first attempt to initiate R&D activities within the water sector was in fact made in 1978 when the Rural Pumping Technology Research Group, later renamed the Research and Development Services, was established under the then Water Works Construction Authority. The activities of the service were limited to the area of R&D on water lifting systems—mainly on hand and wind pumps. The service does not in fact exist at present. Apart from the R&D efforts of the service, higher education institutions such as the Addis Ababa University and Arbaminch Water Technology Institute, the Ministry of Water Resources and the Geological Survey of Ethiopia undertake limited R&D activities. Research areas covered by these institutions include multi-purpose water resources

development, water resources potential evaluation, defluoridation and water treatment. Research activities in irrigation systems, irrigation water demands and crop–water interrelationships undertaken by the Melka Werer Center of the Ethiopian Agricultural Research Organization are also worth mentioning. Research carried out from 1982 to 1985 by the Water Resources Development Authority on ground water level rise and soil salinity of the Amibara Irrigation Development project has also resulted in some useful outputs (ESTC 1998).

Nonetheless, examination of the R&D efforts that have been carried out by various institutions in the water sector reveals that the efforts are very limited when viewed from the point of the water resources potential and the problems related to its management. The problems observed include absence of an institutional body to co-ordinate and undertake R&D activities in the water sector, inadequate recognition of the role of R&D in water resources management, absence of mechanisms to disseminate research results, dependency on foreign funding and inadequacy of the linkages between R&D and development activities in the sector.

Consultancy study on R&D activities in the water sector

The National Mines, Water, Energy and Geoinformation S&T Council recognised the fact that research in the water sector is at its infancy stage, and it identified the issue as its top priority. Hence, the Council designed a terms of reference for a consultancy study to address the problem. Following this, the Ethiopian Science and Technology Commission and the Ministry of Water Resources jointly submitted a project to the government funding and the study was carried out by Metaferia Consulting Engineers PLC from July 2000–October 2002 through funds secured from the government and UNESCO.

Objective and scope of the study

The main objective of the study is to assess and review relevant information and, based on the findings, to provide recommendations for the development of R&D capability and its institutionalisation in the water sector. The major activities accomplished in the study include:

1. Review of water resources potential, utilisation, and R&D policy framework
2. Evaluation of the water sector R&D needs
3. Formulation of R&D strategy and prioritisation of R&D programmes
4. Formulation of institutional framework and
5. Preparation of implementation strategy and programme.

Major outputs of the study

Understanding of the sectoral situation

The review of the existing situation has revealed wide-ranging issues including the problems of drought; inadequate capacity for resource assessment, operation and maintenance; lack and inadequacy of standardisation; unavailability of skilled manpower; low level of participation by stakeholders; environmental problems of the sector and, of course, lack of adequate R&D capability. The study concluded that the R&D activities of the sector are fragmented, un-co-ordinated and lacking any visible achievements so far.

Proposal for a consolidated water R&D policy

The analysis of the existing policy and strategy frameworks, with relevance to R&D in the water sector, revealed the need for a consolidated R&D policy and the study has come up with some important guiding principles, and 'policy elements', together with appropriate strategies. The general policy framework is the promotion of water resources development through the establishment of appropriate institutions with proper management, including co-ordination of R&D activities/projects at the national level. The identified policy elements encompass:

1. management structures
2. availability of adequate and dependable budget
3. enhancement of stakeholders participation
4. effective support to actual water resources developments
5. enhancement of water quality
6. effectiveness and efficiency of resource utilisation
7. means of water allocation and utilisation and
8. information and knowledge build-up in regard to international waters and review of institutional frameworks, including international aspects that impact on the water resources of Ethiopia.

Identified and prioritised R&D programmes

The constraints facing the management of the water resources of Ethiopia are the summations of a number of problems each of which require appropriate solutions that are technically feasible, economically viable and socio-politically acceptable. The solution to these questions can only be found through a concerted and well-formulated research programmes that are practical and targeted towards development of technologies that will enhance sustainable development and integrated management of water resources within the framework of sound environmental conservation practices. To achieve this overall objective of R&D in the water sector, the study has identified wide-ranging and

multi-disciplinary topics that need to be addressed in a well-co-ordinated national effort. These are classified into four major divisions, according to their respective fields of research. The four fields of research are: water resources assessment and management; water resources development; engineering and technology; and socio-economics or the social sciences. Twenty-three R&D programmes have been identified and classified within the four divisions based on disciplinary approach (see Table below).

Prioritisation of R&D programmes

Categories/divisions	First priority	Second priority	Third priority
Water resources assessment and management	Water quality management	Ground water hydrology	Surface water hydrology
		Watershed management	Climatic characteristics
Water resources development	Water supply Irrigation	Water supply for livestock Sanitation Multi-purpose projects	Rainwater harvesting Hydropower Drainage
Engineering and technology	Hydraulic structures	Choice of technology	Traditional technology
		Technology management	Technology development
			Construction site and materials investigation
Socio-economics	Policy and legislative issues	Finance and economics	Institutions and stakeholders
			Capacity building
Total	5	8	10

The R&D programmes are prioritised to ascertain that they are in line with the current sectoral priorities of the national science and technology policy, the water resources management policy and other relevant government policies and strategies.

Prioritisation of R&D programmes

The consultants have categorised the R&D programmes into three priorities within each of the four major R&D divisions (see Table above). Accordingly, the high priority programmes include water quality, water supply, irrigation, hydraulic structures, and policy and legislative issues. Implicit within these priorities is the need to address urgent developmental needs of the sector, with particular emphasis on meeting the basic needs of the population.

It should be emphasised that all of the 23 R&D programmes are important and need to be undertaken both for their own significance and for their integrative requirements with other R&D programmes. It is anticipated that the responsible body can revise and update the prioritisation of programmes according to changing needs and circumstances. As such, the prioritisation undertaken, by the consultants, should not be taken as an absolute rather than as a reasonable starting point to focus on.

Establishment of the water research and development organisation

The overall review and analysis of the national water sector R&D capabilities, and its minimal achievements have led the consultants to the conclusion that the establishment of a water resources research and development institute is of crucial national importance. The need for such an organisation in the water sector is not only apparent, but is also becoming more urgent as sectoral objectives and planned development programmes are receiving enhanced attention by the government, the public and concerned international bodies. The increased sectoral emphasis is a direct outcome of its substantial resource base and its potential to significantly contribute towards the improvement of the desperate socio-economic status of the country.

The need for a comprehensive and integrated management of R&D in the water sector is demonstrated further by the lack of awareness about research activities undertaken and the results achieved. Co-ordination and follow-up of R&D activities in the sector is therefore critical as the existing national capability is, with a few exceptions, negligible, particularly in view of the requirement and the level of development achieved by other countries such as Egypt and India. The consultants have therefore recommended the establishment of water R&D institute with the following objectives and responsibilities.

Objectives of the Institute

The overall objective of the proposed water R&D institute is to contribute towards the implementation of the country's long-term policies and development objectives within the sector itself, and in related development programmes. The specific objectives include:

- contributing towards strengthening the national capability to undertake R&D activities in all fields of the water sector
- undertaking, and cause the undertaking of, multi-disciplinary research to resolve problems, alleviate constraints and maximise opportunities in the development of the country's resources
- taking the overall responsibility for all water sector R&D undertakings through selection and prioritisation of research, funding and co-ordination
- promoting utilisation of research results to enhance sectoral development and
- operating as depository and documentation centre for data, information and research undertakings related to the water sector.

Duties and responsibilities of the institute

The major duties and responsibilities of the envisaged R&D institute include:

- initiating and conducting R&D on water resources particularly in the fields of assessment, management, development, engineering, technology and socio-economics

- guiding, planning, prioritising, funding, co-ordinating, integrating and monitoring all R&D activities in the water sector
- studying the application of various research results carried out in other countries, and the maintenance of a collection of materials, literature and scientific data relating thereto
- disseminating research findings through reports, publications, workshops, seminars, and other appropriate media; and acting as a forum for constructive dialogue on water resources development and management
- operating as a national depository and documentation centre for all research activities that are related with water resources development
- undertaking effective training of R&D manpower, locally and abroad, as necessary, on the basis of the sub-sectoral needs and plans to produce the desired quality and quantity of skilled manpower and
- establishing and strengthening R&D co-operation with international organisations and foreign governments in such a way as to contribute to national water sector R&D capability building.

Organisational requirements of the institute

The Water R&D Institute is proposed to be an autonomous organisation having the overall responsibility and power regarding all national R&D efforts in the water sector. The organisational set-up is formulated in view of the development potential and needs of the water sector; the requirements of a R&D organisation; existing situations and intentions; the problems and constraints of the existing limited research capabilities; and formulation of conducive career structures and incentives. Four alternative organisational set-ups were considered before the elaboration of the selected one. The difference between the alternatives was in the extent of R&D activities carried out by the institute itself; and those carried out in various organisations, but co-ordinated and funded by the institute. The chosen alternative comprises the following five R&D programmes to be established directly under the institute at its initial stage of formation:

- water quality management R&D programme,
- water supply R&D programme
- irrigation R&D programme
- hydraulic structures R&D programme and
- policy and legislative issues R&D programme.

The institute foresees, in time, to develop almost all R&D capabilities within itself, while other continuing co-ordination and funding of R&D activities being undertaken by others.

Funding requirements of the institute

The funding requirements, for the establishment and subsequent operation of the R&D organisation, will be comprehensive and all encompassing. As the establishment is, largely,

for new and non-existent requirements, the development will necessarily be phased over a long-term period. The short-term financial requirements of the proposed institute have been estimated to be in the order of ETB 62.9 million. This amount does not include budget allocations for actual R&D activities/projects during the five-year period. The requirement will depend on the type and number of research undertakings, which can only be determined by the institute, probably starting in the second year.

The long- and short-term programmes

The long-term (21–50 years) organisational objective is to establish a national R&D institute capable of undertaking most of the research activities of the water sector. This involves:

- a gradual build-up of institutional capability, starting with establishment of the institute, co-ordination and funding of R&D activities by existing organisations
- undertaking studies for the establishment of own capabilities, starting with selected and critical fields of research and for gradual expansion to encompass all the research fields envisaged to be handled by the central institute. Those few fields of research that remain in the centres of excellence shall be strengthened, coordinated, and funded by the Institute.

The major short-term (five years) activities of the proposed institute include:

- establishing its legal and physical framework
- establishing linkages with relevant national and international organisations for technical co-operation and funding
- undertaking R&D activities, both through its own programmes and through existing centres in the various organisations
- co-ordinating and funding of all R&D activities in the water sector
- preparatory works to construct the institute's headquarters
- undertaking organisational matters including staffing, funding, collection of information and data and
- working the details of the institute's management, administrative and financial systems including manuals and guidelines.

The institute will have to start its short-term activities in rented premises, until it builds its own headquarters complex.

Conclusions

The activities that have been carried out towards building capacity in water resources management R&D in Ethiopia are encouraging. The consultancy study has evaluated the prevailing situation and clearly indicated the way forward. The logical next step is the implementation of the results of the study as soon as possible. It is strongly recommended that all current and future bilateral and multilateral co-operations in the area of water management R&D should focus on building the organisational, infrastructural, and

manpower capacities of the proposed water R&D institute. Training of the appropriate research personnel in the desired quantity and quality should in fact be at the core of such collaborations. Another important step that needs to be taken as soon as possible is defining the framework of the envisaged guidance, co-ordination and funding of the R&D activities undertaken by the various federal and regional institutions. This has, of course, to be worked out with the participation of all the stakeholders.

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